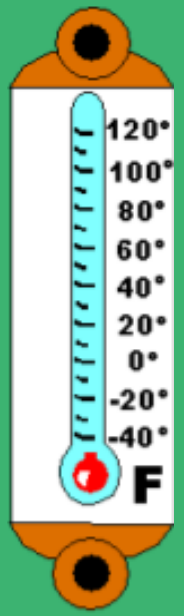
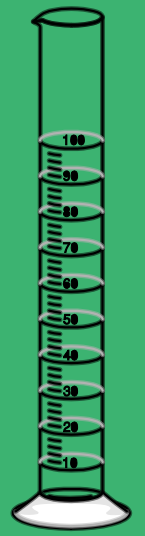
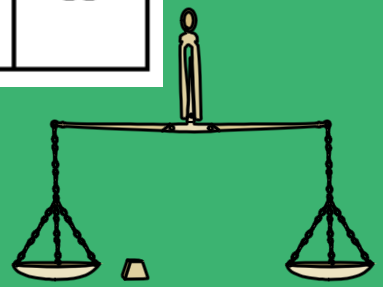
1.2 Measuring



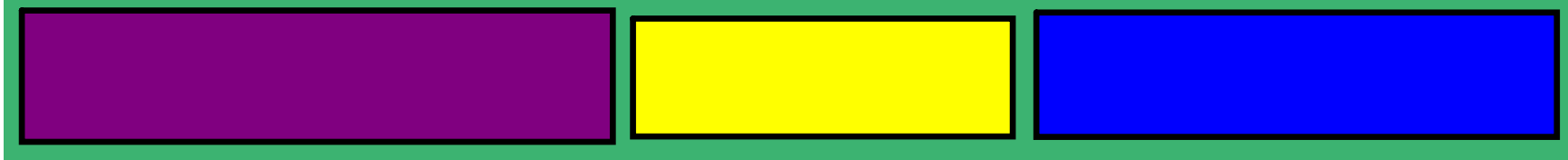


Curriculum Outcomes	Related Activities	Page in Text
• determine accuracy and precision of a measurement • demonstrate an understanding of the concerns and issues that pertain to the collection of data	• carry out specific measurement activities using an appropriate level of precision	9
	• discuss and determine the number of digits students feel confident reading and recording when making the same measurement using scales of different fineness	9
	• investigate, through measuring activities, possible inaccuracies that produce different results	10
	• relate precision and the number of significant digits for the same measurement	11
	• perform measurement calculations and report results with appropriate level of precision and significant digits	11



Accuracy

If these shapes are measured multiple times by different people, will everyone find the same measurement?



Precision

Which ruler will give us a more precise measurement of this shape?

Notes

Accuracy: indicates how close the recorded measurement is to the true value. It is dependent upon the user's skill in using the measuring tool.

Precision: is the smallest unit that can be measured with confidence using the measuring tool and is determined by the fineness of the scale on the tool.

Accuracy

The accuracy of a measurement indicates how close the recorded measurement is to the true value. It depends on the user's skill in using the tool.

When measuring with a ruler, you must start at the 0 mark, and look straight down on the ruler in order to get an accurate measurement.

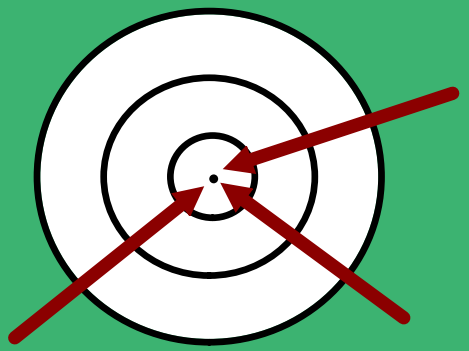
Other factors like temperature, humidity, and the conditions of the tool can also influence accuracy.

Precision

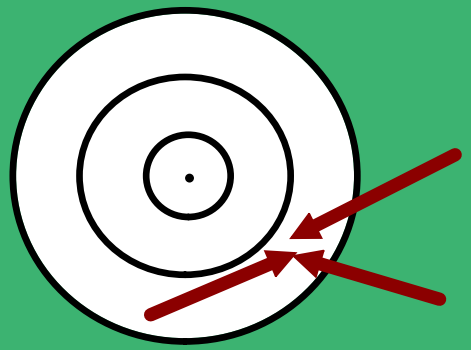
The precision of a measurement is the determined by the size of the units that can be measured with confidence using the tool. The smaller the unit, the more accurate the measurement.

How are accuracy and precision alike and different?

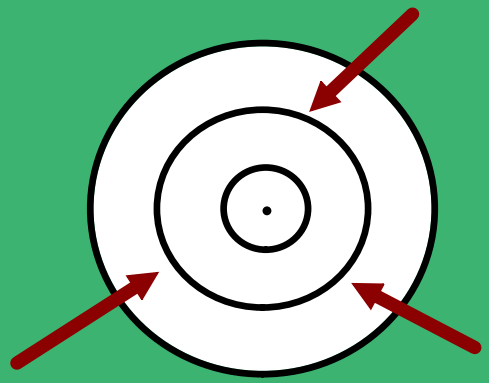
- **Example: Arrows on a target**



Good accuracy
Good precision



Good precision
Poor accuracy



Poor precision
Poor accuracy

Focus C: Accuracy and Precision

Accuracy:

- **three differenct people using same ruler get different answers.**

Precision:

- **greater number of digits increases precision.**

Classwork:

Do Focus Questions Pg.9 #2,3,4

#2. It is important to use the same tool to measure length and width because then when you find area your answer will be as precise as both measurements.

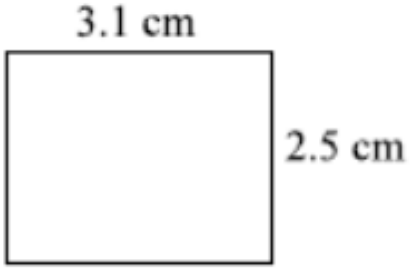
#3. 100.0 tells us that the measurement is EXACTLY 100m, while 100m means that it might have been rounded.

#4. Should the precision of the calculated measurement be considered the same as the least precise measurement????? Explain.

Why significant digits?

When you do calculations involving measured values, your answer can only be as precise as the least-precise measured value.

Consider the rectangle below. The length and width (3.1 cm x 2.5 cm) are precise to the tenth of a centimetre . If you calculate the area (A = L x W), the result is expressed in hundredths of a centimetre (7.75 cm^2). This is a more precise measurement than the original length and width, and is not correct.



So, the area of this rectangle must be expressed as 7.6 cm^2.

Notes

Significant Digits can help you make decisions regarding the least precise measured value. This process is understood universally.

Rules for Significant Digits

1. All nonzero digits (1,2,3,4,5,6,7,8,9) in a measurement are always significant.

Measurement (cm)	Number of Significant Digits	Measurement (cm)	Number of Significant Digits (fill in answer)
2.45	3	5.7	
34.5678	6	22391	
2.1	2	34993	
3.456	4	2.451	

2. Zeroes appearing between nonzero digits are significant.

Measurement (cm)	Number of Significant Digits	Measurement (cm)	Number of Significant Digits (fill in answer)
10001	5	100.38	
30.39	4	10.4	
12.0005	6	200005	
2.01	3	7.004	

3. Zeroes appearing in front of all nonzero digits are NOT significant.

Measurement (cm)	Number of Significant Digits	Measurement (cm)	Number of Significant Digits (fill in answer)
0.0034	2	0.000 000 000 2	
0.000 000 05	1	0.5681	
0.08734	4	0.000438	
0.00405	3	0.00091	

4. Zeros at the end of a number and to the right of the decimal point are significant.

Measurement (cm)	Number of Significant Digits	Measurement (cm)	Number of Significant Digits (fill in answer)
3.500	4	7.00	
96.0	3	872.3400	
5.000	4	48.00	
9.0	2	12.000	

5. Zeros at the end of a number which has **no** decimal point are NOT significant.

Measurement (cm)	Number of Significant Digits	Measurement (cm)	Number of Significant Digits (fill in answer)
450	2	34 000 000 000	
82450	4	8 657 480	
5 000 000	1	600	
983 000	3	32 340 000	

Classwork/Homework:

- Pg. 10 # 6, 9
- Answer "Comparing measuring tools" Questions
- Study the rules for significant digits
- If you finish early, work on the left-hand side of the worksheet.

Compare the measuring tools which are illustrated on page 7 of your textbook.
Answer the following questions.

1. Which tools measure time?

_____

2. Which tool measures time more precisely?

_____

3. Name another tool which measures time.

_____

4. Which tools measure temperature?

_____

5. Which measures temperature more precisely?

_____

6. How could a person make an error in using an ear thermometer?

_____

7. Which tool measures mass?

_____

8. Which tool measures volume?

_____

9. Which measures more precisely - the scale balance or the graduated cylinder?

_____

10. How could a person make an error when using the graduated cylinder?
Would this error affect the accuracy or the precision of the measurement?

_____

_____

Warm-Up

- Tell me how many significant digits each of the following have:

1. 0.003
2. 10035
3. 2110.0
4. 1000
5. 99.0024
6. 234.00120
7. 78001
8. 10.00
9. 0.00034
10. 73.020

Adding and Subtracting

When adding or subtracting your answer can only show as many decimal places as the measurement having the fewest number of decimal places

Examples:

1) 24.6866 m → 4 decimal places
2.343 m → 3 decimal places
+ 3.21 m → 2 decimal places
30.239 m
↓
30.24 m (2 decimal places)

2) 6.201 cm → 3 decimal places
7.4 cm → 1 decimal places
0.68 cm → 2 decimal places
+ 12.0 cm → 1 decimal places
26.281 cm
↓
26.3 cm (1 decimal place)

Multiplying and Dividing

When multiplying and dividing. your answer may only show as many significant digits as the multiplied or divided measurement showing the least number of significant digits.

Examples:

1) 131 m → 3 significant digits
x 2.8 m → 2 significant digits
366.8 m
↓
370 m → 2 significant digits

2) 40.02 m → 4 significant digits
13.0005 sec → 6 significant digits

3.078343141 m/sec
↓
3.078 m/sec (4 significant digits)

Classwork/Homework

Do Questions:

- on left-side of worksheet (Operations with significant digits)

	Answers
1) 6.201 cm + 7.4 cm + 0.68 cm+ 12.0 cm	
2) 1.6 cm + 1.62 cm + 1200 cm	
3) 8.264 g - 7.8 g	
4) 10.4168 m - 6.0 m	
5) 12.00 kg + 15.001 kg	
6) 84.675 cm - 3 cm	
7) 17.95 km + 32.42 km + 50 km	
8) 10 g - 9.9 g	
9) 42.828 m + 67.4629 m	
10) 53.4028 kg - 14 kg	
11) .04 cm x 2.7 cm	
12) 145 cm x 9.3 cm	
13) 20.2 m divided by 7.41 sec	
14) 30.012 g divided by 11.000007 ml	
15) 7.6 cm x 21.9 cm	
16) 2.15 km x 3.1 km x 100 km	
17) 5.00009 g x 0.06 g	
18) 38 m divided by 7 s	
19) 6008 g divided by 3.00 ml	
20) 600 000 cm divided by 2.07 s	

These are the questions that were handed out in class.